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Hybrid Christmas Tree—page 8

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AGRICULTURAL
Research

December 1964/Vol. 13, No. 6

The HOW of Research

Laboratory techniques may not always make headlines, but there are times when a technique is of more general news value than a research finding.

Two such cases came to our attention recently, both enabling large savings in research time:

First, an ARS agronomist has perfected a simple and accurate method for predicting winter hardiness of varieties of winter oats (see page 15, this issue).

Second, an ARS animal husbandman developed techniques and methods—employing automatic equipment and computers—for energy metabolism studies of dairy cows. These studies are aimed at improving efficiency of feed utilization.

The new winter hardiness test for oats promises to be of significant value in expanding areas in which winter oats can be grown. This in itself is important, but consider also how much quicker hardiness can now be determined.

Using the new test, scientists classified 122 varieties and selections of oats for winter hardiness. They tied up freezer equipment for only 3 days. If they had used the former method, freezer equipment would have been in use 15 weeks—or 32 times as long.

Beyond this, who is to say what crops besides oats may be evaluated by this new technique?

Energy metabolism studies have been made on 150 dairy cows at Beltsville, Md., since early 1963. During the previous 50 years, only 110 such studies were conducted in all of the energy metabolism laboratories in the world.

Because of the time and expense involved in round-the-clock collection and recording of data on live animals, scientists have avoided making energy metabolism studies. The techniques developed by W. P. Flatt provide new opportunities for studying animal nutrition, which in turn may lead to more efficient and economical production of milk and other livestock products.

The 150 metabolism studies on cows at Beltsville cost $67,500 for salaries and computer rental. If these studies had been run in the manner used at other laboratories, they would have cost nearly $500,000.

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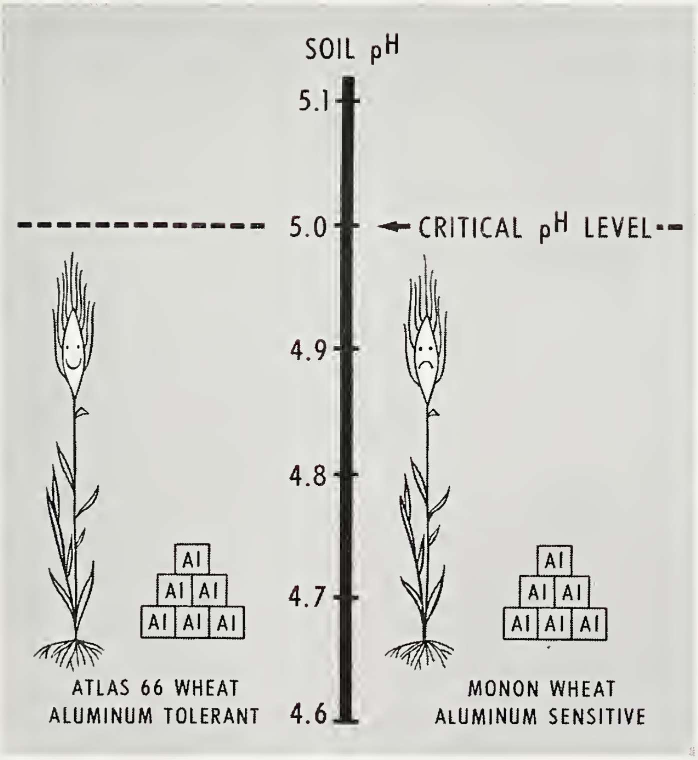
Orville L. Freeman, Secretary,
U.S. Department of Agriculture

B. T. Shaw, Administrator,
Agricultural Research Service

Studies of wheat and aluminum-toxic soils pinpoint new-found genetic characteristic



ROOTS ALTER pH

■ Varieties of wheat differ in their response to high levels of aluminum mainly because of the varying effects their roots have on soil pH.

This root characteristic has been identified by ARS soil scientists C. D. Foy, G. R. Burns, J. C. Brown, and A. L. Fleming in research at Beltsville, Md. They grew Atlas 66, an aluminum-tolerant variety, and Monon, an aluminum-susceptible variety, in soil that was acid and that had a high aluminum content.

The scientists found that roots change pH in their immediate vicinity—and that the altered pH around Atlas 66 roots is higher than the altered pH around Monon roots.

The lower pH (higher acidity) surrounding Monon roots causes more aluminum to go into solution, the scientists explain, and this extra amount of aluminum causes toxicity. It is not yet fully understood how aluminum harms plants.

This finding reveals at least one characteristic (ability of plants to alter pH around their roots) that is responsible for the reaction of wheat plants to high aluminum levels. It may not be the only character involved, but it almost certainly is the principal one.

This important basic finding has led to research in which the soil scientists and plant geneticists D. A. Reid and L. W. Briggle are attempting to determine the physiological and genetic nature of aluminum tolerance in barley and wheat.

Aluminum toxicity is a serious problem in humid-area soils having a combination of high soil acidity and a high aluminum level. Aluminum-sensitive plants suffer in such soils when the acidity becomes high enough (below pH 5.0) to dissolve large amounts of aluminum.

In the United States, aluminum toxicity affects sensitive plants in much of the Southeast. It is not a general problem in other parts of this country but is widespread in South America and in other humid areas of the world.

The problem of toxic aluminum in acid surface soils can be corrected by liming. Aluminum in subsoils may remain toxic, however, because lime does not readily penetrate below the zone of application in many soils. Hence, even in limed soils excess aluminum in the subsoil may restrict plant roots and render the plants more subject to drought. Costs of liming the subsoils are usually prohibitive.

ROOTS ALTER pH
(*Continued*)

At present the best answer to the problem of aluminum-toxic subsoils is to develop aluminum-resistant varieties. If geneticists can locate and manipulate the genes carrying the resistance-giving character, they have a good chance of developing commercial varieties with greater aluminum tolerance. Such varieties should be better able to exploit acid subsoils and be less subject to drought.

The first phase of the Beltsville research was conducted to test a hypothesis developed in earlier experiments—that roots of Atlas 66 adjust the pH to a higher level than do the roots of Monon.

The scientists confirmed this hypothesis by growing plants in nutrient solutions and in small beakers of soil. They then set up another experiment to determine whether the effect roots have on pH is general or local. In this phase of the research, they grew thick stands of both wheat varieties in the same pots of a high-aluminum acid soil. The indicator, they knew, would be plant growth:

—If pH were affected only in the immediate vicinity of the root, the roots of each variety would have no effect on the pH of soil surrounding roots of the other variety, and each variety would grow at its normal rate.

—If, on the other hand, pH effect extended beyond the immediate vicinity of the roots, the roots of each variety would have some effect on pH surrounding roots of the other variety and this influence would be reflected in growth rate.

Each variety grew at its typical rate in the acid soil. Thus, even though roots were crowded, neither variety was affected by pH changes caused by roots of the other variety. This indicated that the layer of altered soil around the root is extremely thin.☆

In Idaho and Oregon, deep plowing offers permanent solution to . . .

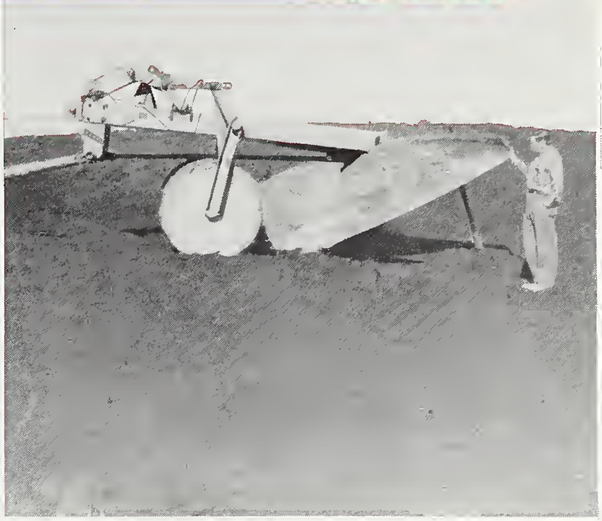
SLICK SPOTS

■ Deep plowing to a depth of 30 to 36 inches is permanently reclaiming low-producing "slick spot" soils in the lower Snake River Valley of Idaho and Oregon. The soils occupy about 250,000 acres of irrigated or potentially irrigable lands.

Crop yields—on even moderately affected fields—may be reduced as much as 50 percent.

Research by ARS soil scientist W. W. Rasmussen indicates that the cost of deep plowing and knocking down the plow ridges—averaging $35 to $45 per acre when done by a commercial contractor—can usually be recouped through increased yields within 2 to 3 years.

The "slick spots" consist of naturally occurring saline-sodic soils, which occupy 10 to 50 percent of fields on the steeper benchlands of south-



Deep plowing was varied in the studies from 30 to 36 inches deep. Here, two tractors plow to a 36-inch depth in Chilcott-Sebree soil that was affected by slick spot. A single tractor pulled the same plow at a depth of 30 inches on other test land of the same soil type.

western Idaho and southeastern Oregon. They are so-called because the soil surface is slick and shiny when wet. Moisture penetrates them very slowly, and farming operations are delayed in the spring because the soils are slow to dry out.

Rasmussen's work near Caldwell, Idaho, has been concentrated on the Sebree silt loam soil, one of the three soil series in which the slick spot condition occurs. The Idaho Agricultural Experiment Station, the U.S. Bureau of Reclamation, and the Black Canyon Irrigation District are cooperating in this research.

TOP LEFT—Alfalfa in this plot—shown just before second cutting—was grown on land that was affected by slick spot. Soil was deep-mixed to simulate plowing to a 30-inch depth. Yield was at a rate of 8.5 tons of air-dried hay per acre.

BOTTOM LEFT—By comparison, this plot, which had not been treated against slick spot, yielded at a rate of only 1.25 tons per acre.

The soil scientist has identified three reasons for reduced productivity of Sebree soils: The moderately high content of sodium in the clay subsoil (exchangeable in this case with calcium) greatly restricts water intake and penetration; the clay material of the subsoil causes it to take up moisture slowly; and a cemented loam layer at 17- to 22-inch depths restricts both moisture and root penetration.

Deep plowing effectively corrects all three conditions and, as a dividend, also improves the physical condition of Chilcott soils, which are interspersed with the Sebree "slick spots." The Chilcott soils are not affected by salt.

The plowing brings up and incorporates naturally occurring gypsum (a high calcium material) and calcium carbonate into the soil. The calcium displaces the sodium, coagulates the soil, and helps increase moisture movement for leaching away excess sodium. The deep plowing also mixes the heavy clay subsoil with the light-textured topsoil and breaks up the cemented soil layer.

Thorough mixing of the soil allows moisture and plant roots to readily penetrate to plow depth of 30 to 36 inches. Plants seldom root deeper than 12 to 14 inches in the untreated soils. The deep plowing should also materially improve water-use efficiency.

Although 2 to 3 years are required to leach sodium from the soil, crop yields are increased the first year after treatment. One Idaho farmer produced 15 tons of sugarbeets to the acre on a slick-spot field before treatment and 27 tons per acre the first year after deep plowing. On the slick-spot areas, the yield increase may be five- or six-fold.

The plowed fields, which require leveling to facilitate irrigation, also need nitrogen, phosphorus, and possibly zinc fertilizer.

Efforts by farmers to improve moisture penetration by spreading manure or straw on the soil were ineffective.

Rasmussen's earlier experiments showed that subsoiling in two directions plus application of 15 tons of gypsum removed the excess sodium (AGR. RES., April 1960, p. 12) but did not improve the physical condition of the soil materially. And the subsoiling, which costs as much as deep plowing, was of no benefit when used alone.☆

Harvesting Narrow-Row Cotton

Experimental machine strips 92.5 percent of cotton from 10-inch rows

■ An experimental machine, developed by ARS agricultural engineers for harvesting cotton planted in narrow rows, has performed well in Texas tests.

The narrow-row harvester stripped 92.5 percent of the cotton from plants in 10-inch rows at the South Plains Research and Extension Center, Lubbock. The engineers say that 92.5 percent is a remarkably high efficiency for an experimental machine, and they expect to make improvements that will further increase efficiency.

I. W. Kirk, E. B. Hudspeth, and D. F. Wanjura developed the narrow-row harvester in cooperation with the Texas Agricultural Experiment Station.

Widespread interest has existed for several years in growing cotton in narrow rows because it would eliminate machine cultivation and hand-hoeing—two big production costs. But widespread adoption of the practice has been prevented by two obstacles: weed control in young cotton—and mechanical harvesting.

Recently developed pre-emergence herbicides offer an acceptable solution to the weed control problem. And ARS engineers now have established the mechanical principles for building a high-speed, efficient, and economical harvesting machine.

The engineers incorporated the finger principle of stripper harvesting into the machine. They removed the picking units from a conventional commercial harvester, replacing them with a single stripping unit especially designed for narrow-row harvesting. A series of angle-iron fingers, 36 inches long and spaced ⅝ of an inch apart (see photo), were made into a unit that strips a 104-foot swath.

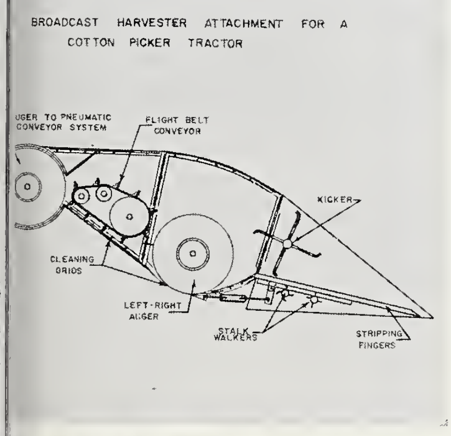
Short stormproof cotton was grown in the Texas tests. As the best cotton now available for narrow row culture, it has short, small-diameter stalks with little branching. Plant breeders have started work aimed at developing cotton that will be even better adapted to this type of culture.

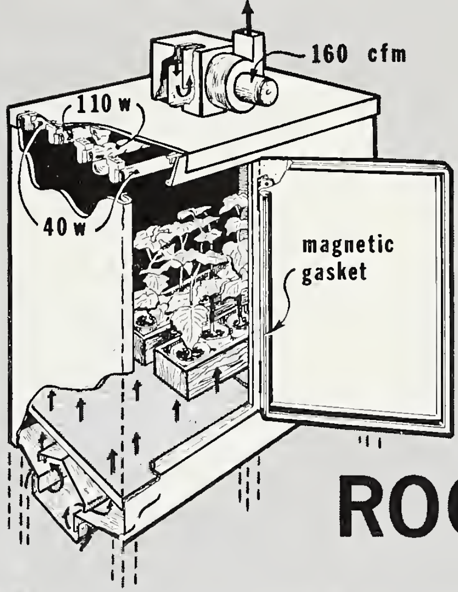
The narrow-row harvester can be used to harvest cotton grown in conventional 40-inch rows. In tests at Lubbock it was almost as efficient as the two conventional machines with which it was compared. It harvested 97.2 percent of the cotton compared with 98.6 and 98.8 percent for the conventional machines.☆

←

A conventional harvester was adapted for stripping bolls—from a 104-inch swath—in fields of cotton planted in narrow rows.

Stripping fingers (see diagram and picture) are spaced ⅝ of an inch apart with flexible mounting to permit a stalk of up to 1-inch in thickness to pass through.





for plant-growth studies

ROOMETTES

A plant growth chamber is one of the most helpful and versatile tools used by a plant scientist. Although many kinds are in use, there is need for a simple, inexpensive roomette in which investigators can grow plants under controlled light conditions in any air-conditioned room or laboratory.

A movable roomette that has proved its worth in exacting ARS research at Beltsville, Md., should meet this need. It was designed by plant physiologist R. J. Downs and agricultural engineers W. A. Bailey and H. H. Klueter.

Walls of the roomette are of 20-gauge, galvanized steel, painted semi-gloss white inside and gray outside. The length, 50 inches, is predetermined by the length of the fluorescent lamps. It is 24 inches wide; and 36 inches deep. Magnetic gaskets on the doors assure a firm, light-tight seal—and easy opening and closing.

Air enters the bottom through a longitudinal slot that is baffled to keep out light (see diagram). Air is pulled through a perforated-metal floor and exhausted out the top by a centrifugal blower rated at 160 cubic feet per minute. No insulation is needed since the roomette is maintained at room temperature.

Light can be controlled uniformly throughout the roomette at several intensities. Both incandescent and fluorescent lamps are installed and are controlled separately.

The roomette contains four standard screw-base ceramic sockets for incandescent lamps, lampholders for two 40-watt, rapid-start fluorescent lamps, and two 100-watt, 1,500-ma fluorescent lamps. Wires from the lampholders and blower are brought to a terminal board at one end of the cabinet through a metal wire-way.

Flexibility of use is one of the main advantages of the unit, which could be made portable if desired. It can be used individually or grouped with others in such a way that light in several units can be controlled through a central panel. ARS now has eight of the roomettes, all in one room. Light in all units is controlled through a panel in another room.

The ARS units were built by a commercial sheet metal firm, at $300 each, but any institution with shop facilities could build its own.☆

HYBRID CHRISTMAS TREE . .

Rapidly growing hybrid can be harvested at 5 years . . . with decorative cones

This cross section of the lower trunk of a young hybrid illustrates the rapid growth that is made by the hybrid Christmas tree. Note the width of its annual rings.

ABOUT THE COVER—A bough from the new hybrid has its own pine-cone decorations, which develop when the tree is 5 years old.

■ Christmas trees grown to order, with ornaments attached. They are a possibility now—not this Christmas nor the next; but in 1967 growers will receive young trees for field testing.

The Christmas tree came to the Forest Service almost as a bonus from a long program of hybridization at the Pacific Southwest Forest and Range Experiment Station's Institute of Forest Genetics, Placerville, Calif. From Institute research, aimed primarily at better wood from faster growing trees, has now come a hybrid pine ideally suited for that bright spot in the house on Christmas morning.

The hybrid—a cross between the Sierra Nevada lodgepole pine and the shore pine—grows fast, about 6 feet in 4 to 5 years. It develops more than one whorl of branches each year to produce a full, many-branched tree with a conical shape and straight trunk. The hybrid has a thick dark-green foliage and produces cones when it is 5 years old, the cones decorating the tree just as it reaches the right size for harvesting.

Some of these desirable characteristics for Christmas tree production, combined in the hybrid, are lacking in each of the parent varieties.

FOR THE 1970s

Desirable characteristics of both the shore pine (left) and the Sierra Nevada lodgepole pine (center) were combined in the new hybrid Christmas tree (right). The hybrid develops more than one whorl of branches each year and has a conical shape and a straight trunk.

The Institute's scientists started work on producing the hybrid in quantity this year, in a cooperative project financed mostly by the California Christmas Tree Growers, who will receive the trees in 1967 for transplanting.

The scientists say the hybrid Christmas tree can be produced in quantity because there are no major genetic barriers to crossing the lodgepole pine and the shore pine, both varieties of the same species. There is difficulty in many cases in crossing pines of different species.

Quantity breeding for the Christmas tree began in 1963, when tree geneticists at the Institute collected a large amount of pollen from several trees in a natural stand of Sierra lodgepole pine. Last spring, the scientists used this pollen to pollinate shore pine, of several geographic sources, growing in the Institute's arboretum. Several hundred conelets developed from the pollinated flowers, and the geneticists expect 3,000 or more viable seed in 1965.

The seed will be planted in the station nursery in 1966, and seedlings should be ready for transplanting in 1967.

The California Christmas Tree Growers will grow most of these trees in a wide variety of environments. The Institute will transplant a few of the seedlings for further study of the ability of the hybrid Christmas tree to reproduce itself.

The hybrid can be produced by crossing lodgepole with shore pines in either direction. The geneticists have made the reverse cross—lodgepole pollinated with shore pine pollen, and they expect to harvest about the same number of seeds from this cross as from the first cross (shore pine pollinated with lodgepole pollen).☆

Soil Nitrogen...

What happens to fertilizer nitrogen once applied to the soil?

What happens to fertilizer nitrogen after it is applied to the soil, and what form of soil nitrogen depletes most rapidly with continuous cultivation? Basic research by ARS and Colorado Agricultural Experiment Station soil scientists offers partial answers.

Experiments by L. K. Porter and B. A. Stewart of ARS and D. D. Johnson of Colorado at Fort Collins provide information that one day may be used in developing more efficient fertilization practices. Farmers need practical methods for making more effective use of nitrogen fertilizer and, if possible, for restricting the decline of soil nitrogen in cropped land.

The researchers found that a form of organic nitrogen, made up mostly of amino acids, plays the dominant role in changes occurring in soil nitrogen. Approximately three times as much fertilizer nitrogen is converted into amino acid nitrogen as into two other organic forms—even though less than half of the organic nitrogen already in the soils is of the amino acid type.

Other research showed that amino acid nitrogen is the organic form declining most rapidly in continuously cropped Great Plains soils.

The scientists explain that most fertilizer nitrogen is inorganic—the form mainly used by plants. But 80 to 98 percent of the total nitrogen in surface soils exists in organic combination, even though organic matter generally constitutes only about 1 to 3 percent of the total weight of arable soils.

Porter points out that plants—and many micro-organisms—are able to synthesize the amino acids they need from carbohydrates, mineral nitrogen, and sulfur. Where considerable quantities of wheat stubble and other crop residues are left on the land, the soil micro-organisms use these residues along with inorganic nutrients from the soil (including fertilizer nitrogen) to build new microbial proteins and protoplasm.

Stewart, Porter, and Johnson simulated the field situation by mixing fertilizer nitrogen and ground wheat straw in various soils and allowing the soil to incubate under moist conditions at 77° F. The scientists used a tagged nitrogen source (nitrogen 15) that could be differentiated from residual nitrogen. After incubating the soils for 10, 30, 75, and 135 days, they compared the availability of newly synthesized and residual soil organic nitrogen.

Amino acid nitrogen increased during the first 10 days of incubation, and the tagged nitrogen decreased proportionately. At that time, 38.9 percent of the tagged nitrogen had been incorporated into amino acid nitrogen, and only 13.4 percent was in other soil organic nitrogen compounds. The remainder of the nitrogen 15 was in inorganic form.

The proportion of tagged nitrogen in amino acid compounds declined slightly but consistently after further incubation, suggesting that it was moving to a form in which it would be available to plants. The amount of organic nitrogen in the other two organic combinations remained virtually unchanged after the first 10 days of incubation.

In a greenhouse study, the scientists found that once the tagged nitrogen had been converted to soil organic form, it was released slowly into inorganic nitrogen for plant uptake. Less than half of the tagged organic nitrogen was released for plant use during four successive croppings. However, 75 percent of the nitrogen released from organic nitrogen substances in the soil was derived from the amino acid form.

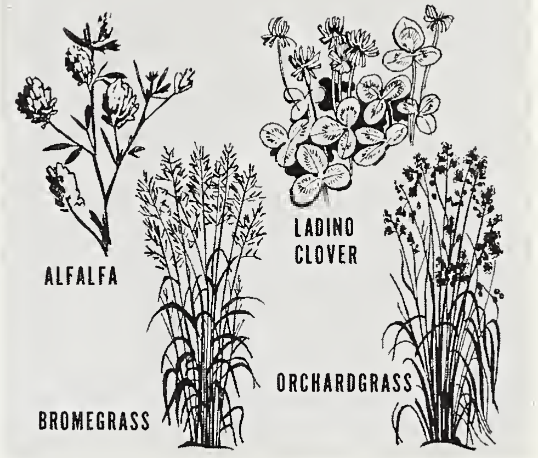
Experiments by Porter, Stewart, and another ARS soil scientist, H. J. Haas, showed that a considerable decrease in nitrogen content of the soil occurs when virgin lands are cultivated. They analyzed virgin soils, and their cropped counterparts, from 14 Great Plains locations. The cropped soils were obtained from experimental sites that had been cultivated 31 to 46 years without addition of fertilizer or manure.

The cropped soils contained, on the average, 38.5 percent less nitrogen than the virgin soils. The amino acid form of nitrogen (about half of total nitrogen in virgin soils) accounted for 61 percent of the nitrogen decrease. The other soil organic nitrogen substances (also about half of the total in virgin soils) contributed only 33 percent of the nitrogen decrease.

Further research is needed to explain why other soil organic nitrogen substances resist change more than amino acid nitrogen.☆

PASTURE MIXTURE...

simple or COMPLEX?



Cattle perform best on combination of two legumes, two grasses in Minnesota tests

■ A simple legume-grass mixture, treated with light applications of nitrogen as the legumes become depleted, proved the most economical pasture in a 5-year study at Rosemount, Minn.

The first of two experiments compared animal performance on simple and complex legume-grass pastures with performance on heavily fertilized all-grass pastures. The second experiment compared the effect of nitrogen on legume-depleted and all-grass pastures.

The research was conducted by agronomists W. F. Wedin and G. C. Marten of ARS and dairy husbandman J. D. Donker of the Minnesota Agricultural Experiment Station. Seeding in 1957, the agronomists established simple legume-grass pastures of alfalfa, ladino clover, bromegrass, and orchardgrass; complex legume-grass pastures of alfalfa, red clover, alsike clover, ladino clover, bromegrass, orchardgrass, timothy, meadow fescue, and reed canarygrass; and all-grass pastures of bromegrass and orchardgrass.

Lactating Holstein cows were used as test animals from 1958 through 1960 and Holstein heifers and Shorthorn heifers and steers in 1961, 1962.

In the first experiment, 1958 through 1959, the legume-grass pastures without nitrogen fertilization were more productive the first year than all-grass pastures heavily fertilized with nitrogen. They were less productive the second year, however, because of severe winterkilling and weakening of legumes. The scientists say it is unlikely that such extreme conditions would occur in every 2-year period; under normal conditions, the legume-grass pastures probably would have outproduced the all-grass pastures both years.

The scientists found no real benefit in having several legumes and grasses in addition to alfalfa and bromegrass. In the complex legume-grass pastures, alfalfa and bromegrass made the only significant contributions to forage production following the first year of grazing. This does not mean that other species should be excluded from pastures. But it does suggest that alfalfa and bromegrass probably should predominate when legume-grass mixtures are seeded where weather conditions are similar to those at Rosemount.

In the second experiment, 1960 through 1962, the scientists continued the heavy nitrogen fertilization of the all-grass pastures started in the earlier experiment. They also began two fertilization treatments—light and heavy applications of nitrogen—on the legume-grass pastures used in the first experiment. The legumes in these pastures had declined by the time the second experiment started.

Light nitrogen fertilization consisted of 40 pounds per acre per year; heavy nitrogen fertilization amounted to 140 pounds per acre the first 2 years and 300 pounds per acre the third year. Over the 3-year period, then, heavily fertilized pastures received 460 pounds more nitrogen than the lightly fertilized pastures.

The scientists found that the lightly fertilized legume-depleted pastures outproduced the heavily fertilized all-grass pastures; that light use of nitrogen was more profitable than the heavy application on legume-depleted pastures; and that animal production was higher on heavily fertilized pastures—but not enough higher to pay for the extra 460 pounds of nitrogen.

By comparing results of both experiments the researchers concluded that heavy annual fertilization of the all-grass pastures for the 5-year span was highly uneconomical, compared with light fertilization of the simple legume-grass pastures. ☆

Photomicrographs help geneticist learn more about cotton fiber and its . . . **BREAKING POINT**

Photomicrographs of individual cotton fibers are helping ARS geneticist Paul A. Fryxell of the University of Arizona Cotton Research Center find the answers to some of the fundamental questions about cotton.

One such riddle centers on how cotton fibers are attached to and removed from the seed. A better understanding of this physical characteristic may lead to the development of cottons with improved ginning qualities.

Will help in selecting better strains

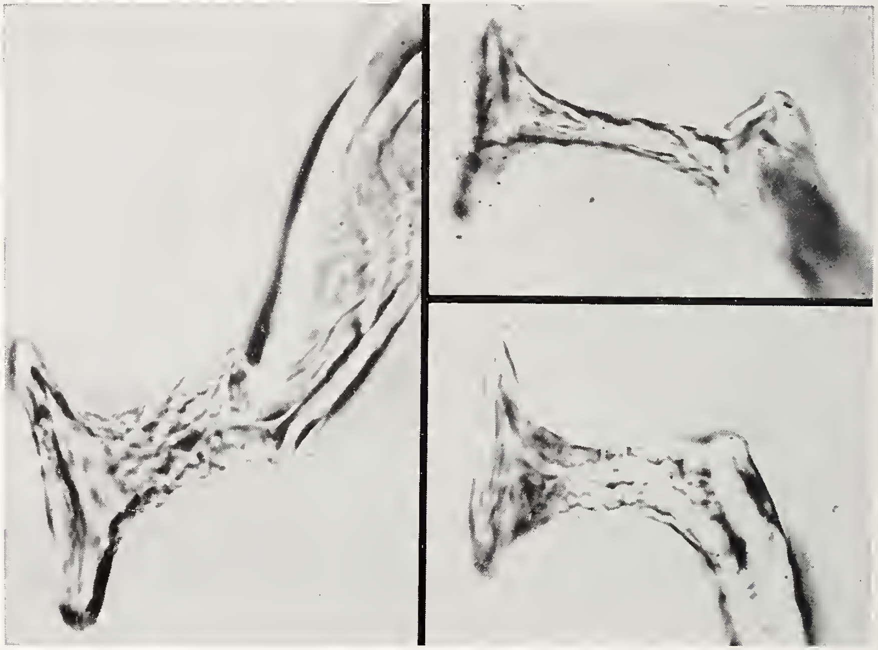
It is already known that certain varieties of cotton will process through the gin more rapidly than others. By gaining a detailed knowledge of how the cotton fiber is attached to the seed, cotton breeders may be able to select for this rapid-processing trait at an early stage in the breeding program. In this way, new strains of cotton may be developed that have improved ginning qualities.

Through photomicrography (photographic enlargement of microscopic objects) Fryxell has observed the elongation into fibers of certain cells on the surface of the immature seed. The fiber cells lengthen to approximately 1,500 times their diameters in only 3 weeks.

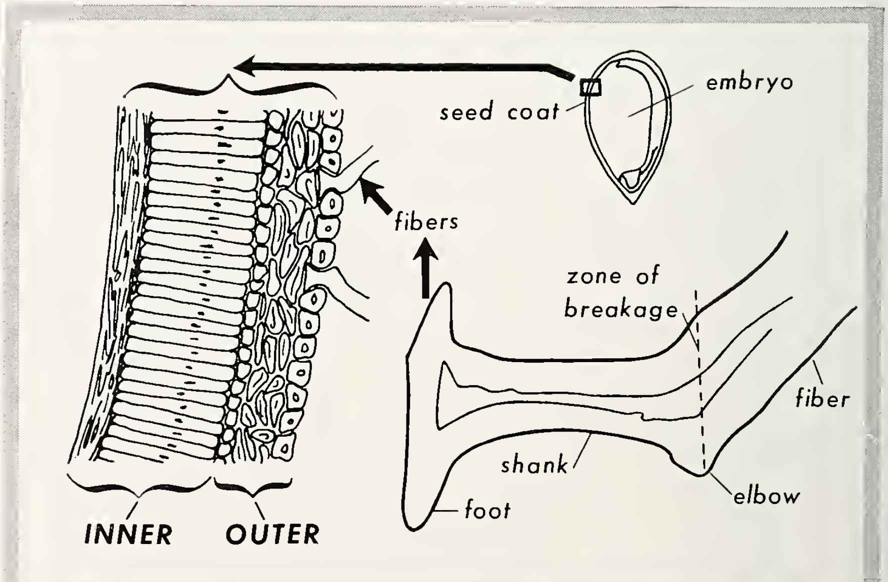
Epidermal cells hold fiber in place

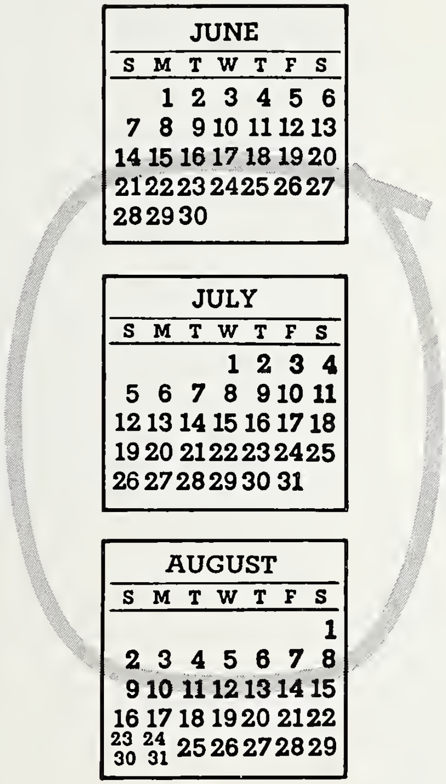
When the cotton boll opens at maturity and the fiber fluffs out, the fiber base, including the shank and foot, is held in place by the surrounding epidermal cells of the outer seed coat (see drawing). The elbow—just above the shank—projects beyond the epidermal cells.

Fibers of cultivated cotton have a weak spot just above the elbow, the point at which the fiber breaks and separates from the seed in the ginning process. Without this weak spot cotton fibers would break at various points. This shortening of the fibers would, in turn, reduce their commercial quality and value.☆



These photomicrographs of the base of three upland cotton fibers (Gossypium hirsutum) illustrate the wide variety found in cotton fiber structure.





Light, Timely Irrigations

Alabama, Georgia scientists allocate cotton water needs during fruiting period

■ One to three light irrigations, applied at the right time, can increase production efficiency for southeastern cotton growers.

ARS scientists, working in cooperation with the Alabama and Georgia Agricultural Experiment Stations, found that irrigating—when the cotton crop is fruiting—should be highly profitable in most years. Cotton fruits from late June to early August, a period of low rainfall.

The scientists point out that growers will not get the full benefit of irrigating unless they combine it with adequate fertilization, insect control, and other good management practices.

Irrigation experiments were conducted by ARS soil scientists B. D. Doss, O. L. Bennett and D. A. Ashley at Thorsby, Ala., and by ARS agricultural engineers J. R. Carreker and J. F. Thornton at Watkinsville, Ga.

The researchers found that the cotton requires about 2 inches of soil moisture each 8 to 10 days during the fruiting period. Since rainfall during fruiting seldom provides that much soil moisture, irrigation would be needed to maintain the desired level.

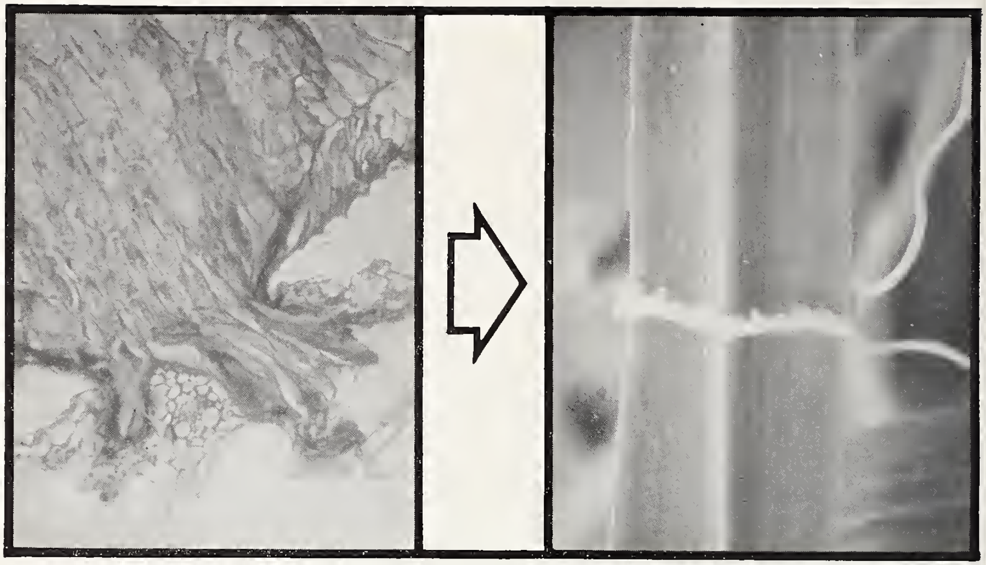
Early in the season, soil moisture is usually adequate for plant growth, so irrigation is not needed. And continuing irrigation after the fruiting period could be harmful; late irrigation in the tests delayed maturity and increased boll rot and plant breakage.

Fibers were longer and somewhat finer from properly irrigated cotton than they were from unirrigated cotton. Although irrigation had little or no effect on the ratio of lint to seed, plants that received ample water throughout the fruiting period did produce more lint and heavier seed.

These findings should interest the cotton-producing Southeast, particularly because of its abundant, though largely underdeveloped, water resources. By conserving water during periods of excess rainfall and using it on crops at critical stages of growth, growers in the Southeast should achieve more efficient crop production.

In the Thorsby experiments, cotton was grown on Greenville sandy loam and was treated with 120 pounds per acre of actual nitrogen. Without irrigation, cotton yielded 2,668 pounds per acre; with limited irrigation to maintain the 2-inch level of soil moisture, it yielded 4,048 pounds per acre; and with frequent irrigation to maintain high soil moisture, it yielded 4,058 pounds per acre. Similar treatments at Watkinsville on Cecil sandy loam gave seed cotton yields of 2,060, 3,297, and 2,956 pounds per acre, respectively.☆

Once the parasitic dodder has attached itself to barley leaf (far right), it transmits disease through infection pegs (haustoria). One of these pegs is viewed microscopically in cross-section (right), after penetrating barley leaf tissue.



Transmitting Virus

Parasite vine transfers BYDV from infected to healthy barley

■ Dodder has done it again—proved itself even more versatile a transmitter of viruses than scientists had known it to be. In this case, however, researchers are happy about the whole thing.

ARS plant pathologist R. G. Timian found that dodder—a well-known vine parasite of broad-leaved plants and sometimes a poisoner of livestock—transmitted barley yellow dwarf virus (BYDV) from infected to healthy barley plants in only 3 days.

Dodder has never before been proved to transmit a grass virus to a grass host, though it does transmit some viruses between broad-leaved plants. Dodder's ability to transmit grass viruses could provide scientists with a needed tool in the study of those diseases that are not easily spread—or that are spread only by insects.

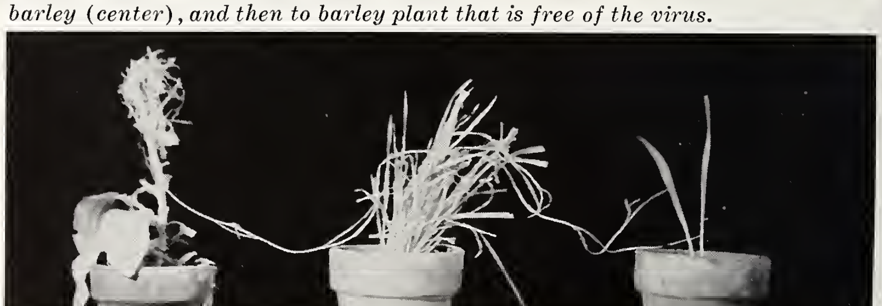
Although dodder does not normally parasitize grasses in nature, it will form temporary attachments to wheat, barley and oats, surviving for as long as 3 weeks on nutrients taken from the grasses—without attachment to other plants. It is during this temporary attachment period—when infection pegs, or haustoria, form on the plants—that dodder spreads BYDV.

Timian was able to transmit the disease from dodder to grass about 56 percent of the time. Refinement of the technique—for use in laboratory studies—should increase this rate.

Inasmuch as dodder transmitted BYDV, it may also be able to transmit other viruses, though it failed in the same tests to spread barley stripe mosaic and wheat striate mosaic.

Timian feels also that it may be possible to transmit grass viruses to broad-leaved plants by way of dodder. If this is so, a laboratory supply of virus could be maintained in broad-leaved plants. These broad-leaved plants then might serve as a source of virus—in a much higher concentration than is present in the grass plant—and facilitate electron microscopic studies as well as serological and biochemical assays.☆

Dodder grows from broad-leaved petunia plant (left), to infected barley (center), and then to barley plant that is free of the virus.



For liming: Dust from cement kilns

Waste dust from cement-manufacturing kilns proved about as satisfactory as agricultural limestone for liming soil in ARS greenhouse tests at Beltsville, Md. Like limestone, the dust reduced soil acidity and provided small amounts of potassium and sulfur as aids to crop nutrition.

Cement kiln dust is formed from materials carried by gases escaping from a cement kiln flue. Part of the dust is collected and returned to the kiln, but the portion that contains too much alkali for use in the manufacturing process—an estimated million tons a year—becomes available for agricultural use.

ARS researchers tested 21 kiln dusts by growing alfalfa in soils that had been limed with these materials. In each case, the dust affected soil acidity and alfalfa yield in much the same way as pulverized limestone when the dust and limestone were applied in amounts having equal soil neutralizing power. On the average, about 1$\frac{1}{5}$ tons of dust were required to equal the neutralizing effects of 1 ton of pure high-calcium limestone, the scientists found. However, some dusts are equal in neutralizing power to many of the limestones that are now used for agricultural purposes.

A speedy test for cold hardiness

ARS researchers have developed a simple and accurate method for predicting winter hardiness of varieties of winter oats. The new technique promises to be of significant value in expanding areas in which winter oats can be grown.

ARS research agronomist H. G. Marshall perfected the technique in cooperation with scientists at the Pennsylvania Agricultural Experiment Station and State Experiment Stations throughout the Northeastern United States. The scientists obtained excellent differentiation between oat varieties for cold resistance.

In tests conducted over a 2-year period, the scientists removed field-grown winter oat plants of many varieties from the soil, clipped their roots and tillers, and froze the plant crowns in individual moisture-proof paper bags. They then allowed the crowns to thaw, transplanted the plants in sand under high moisture conditions on greenhouse benches, and noted survival after recovery periods of 2, 4, 6, and 10 days. Survival was determined by new leaf or root development following the various recovery periods. An accurate determination of survival was possible at the end of 2 days.

New root and leaf growth is shown on oat plants after 6 days of recovery (top) and after 2 days (center). Bottom plants were killed by freezing treatment.

In comparative studies, the scientists found a close parallel between survival of oat varieties in the controlled freezing tests and subsequent survival in the field, indicating that the new test is an accurate predictor of winter hardiness.

The results differ from former freeze tests, in which winter oats were frozen while still potted or in flats, and in which accuracy was low. The former method, moreover, would have tied up freezer equipment for 15 weeks to classify the 122 varieties and selections; the new method required only 72 freezer hours to process the same number of varieties.

New mite is found on beef cattle

The first case in which cattle were found to harbor a new mite (*Psorergatic bos*) was discovered on a New Mexico Hereford cow by ARS workers in 1963. Since then, the parasite has been discovered on 12 other animals from five ranches in New Mexico and Texas.

Attempts to transfer the mite from the original infested cow to other cattle, white rats, and rabbits were unsuccessful.

The mite is extremely small and lacking in form. Even when it is known to be present on a microscope slide, it is very hard to find. Scientists studying the newly discovered parasite give a great deal of credit to Helena Trujillo, laboratory technician at Albuquerque, N. Mex., for finding the first specimen, and to T. A. Hawn for collecting the mite in the field.

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AGRISEARCH NOTES

I. H. Roberts and W. P. Meleney, research veterinarians at the ARS Parasite Research Laboratory, Albuquerque, believe that the mite is a widely distributed parasite of cattle that has escaped detection because of its small size and apparent inoffensiveness to its host. The infested animal does not scratch or itch. The baldness sometimes found on infested animals resembles many other parasitic or nutritional conditions.

Psorergatic mites have been known for several years to infest sheep, some species of rodents, and primates. These mites are about one-third the size of the common scab mites and, in sheep, cause a loss of wool, damaged fleece, and itchiness.

Soil fertility affect lint quality?

Cotton lint quality—fiber length, fineness, and strength—was not affected by the fertility of the soil in research conducted cooperatively by Oklahoma and ARS scientists.

Tests made at two locations in southwestern Oklahoma indicated that lint quality, unlike lint yield, is relatively stable and is not significantly altered by a fairly wide range of soil fertility.

Agronomists J. C. Murray and R. M. Reed found that once sufficient soil nutrients are available to allow a seed to develop, the levels of nitrogen, phosphorus, and potassium in the soil apparently do not determine the properties of the cellulose seed hairs. Other research has shown that soil fertility, as part of the total environment, affects lint quality under more extreme growing conditions than those that existed in the Oklahoma

tests.

Murray and Reed conducted the research under dryland conditions near Mangum, Okla., and at an irrigated site near Altus, Okla. Cotton varieties used were Austin, which was grown at Altus, and Lankart 57, grown at Mangum.

At both test locations the soil was deficient in nitrogen and phosphorus. When these elements were added to the soil, lint yields increased at both sites; but there was no significant difference between the fiber quality of cotton grown in fertilized and unfertilized plots.

Drugs only? Management needed

Medication cannot replace good management of lambs for preventing losses from internal parasites. Experiments that were conducted at Beltsville, Md., from April through September of 1962 and 1963 illustrated the fallacy of relying solely on drugs in the control of parasites.

Lambs on contaminated pastures developed clinical parasitism despite free-choice and therapeutic medication with phenothiazine or dosing with thiabendazole. Lambs on drylot or on newly renovated pastures also received phenothiazine and remained essentially parasite free.

For these experiments, lambs born at the Agricultural Research Center were divided into 4 bands. Band 1 was kept in drylot or rotated on new pastures; band 2 was rotated on so-called clean pastures, and bands 3 and 4 were grazed on separate, contaminated pastures.

Lambs of bands 1, 2, and 3 had continuous access to phenothiazine-mineral mixture; and all animals

within these bands were given purified phenothiazine when biweekly counts of parasite egg had approached 1,000 eggs per gram of feces. On a similar basis, band-4 lambs were dosed with thiabendazole.

Results of these experiments showed that lambs kept essentially free of parasites (band 1) made excellent weight gains, exceeding the gains made by bands 2, 3, and 4. Lambs on clean pastures gradually developed moderate parasitic infections during the latter part of the grazing season. And lambs that were on contaminated pastures became severely parasitized.

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